Claims

1. A functional element (10, 110, 210, 310, 510, 610, 710, 810), in particular a bolt element, consisting of a shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) and a head part (16, 116, 216, 316, 416, 516, 616, 716, 816) designed for a riveted joint to a panel element, in particular a sheet metal part (30, 130, 230, 330, 430, 630, 730), wherein at least the head part is made hollow and has at least substantially the same outer diameter as the shaft part, characterised in that the end (20, 120, 220, 320, 420, 520, 620, 720, 820) of the head part (16, 116, 216, 316, 416, 516, 616, 716, 816) remote from the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) is made in a known manner with piercing and riveting features, and in that the length of the hollow head part (16, 116, 216, 316, 416, 516, 616, 716, 816) is dimensioned at least such that its length amounts to the length of a rivet flange (37, 137, 237, 437, 637, 737) formed on the side of a sheet metal part (30, 130, 230, 430, 630, 730) remote from the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) plus the thickness of the sheet metal part and the double length of the radius of an annular fold (52, 152, 252, 452, 652, 752) formed on the side of the sheet metal part adjacent to the shaft part (14, 114, 214, 314, 414, 514, 614, 714).

2. A functional element (10, 110, 210, 310, 410, 510, 610) in accordance with claim 1, characterised in that the end (20, 120, 220, 320, 420, 520, 620) of the hollow head part (16, 116, 215, 316, 416, 516, 616) merges into a rounded off punching and drawing edge (26,

628) from the circular cylindrical jacket surface and has a conical cutting face (26, 426 626) on the inside.

3. A functional element (10, 110, 210, 310, 410, 510, 610, 710, 810) in accordance with one of the preceding claims, characterised in that the inner space (18, 118, 218, 318, 418, 518, 618, 718, 818) of the hollow head part (16, 116, 216, 316, 416, 516, 616, 716, 816) is at least substantially of a circular cylindrical shape.

4. A functional element (310, 410, 510, 610) in accordance with one of the preceding claims, characterised in that the shaft part (314, 414, 514, 614) is also made hollow.

5. A functional element (10, 110, 210, 310, 610, 710, 810) in accordance with one of the preceding claims, characterised in that the shaft part (14, 114, 214, 314, 614, 714, 814) is provided with an external thread (12, 112, 212, 312, 612, 712, 812).

6. A functional element (410) in accordance with claim 4, characterised in that the hollow shaft part (414) is provided with an internal thread (412).

7. A functional element (10, 110, 210, 310, 410, 510, 610, 710, 810) in accordance with one of the preceding claims, characterised in that it is made as a cold formed part.

8. A functional element (310, 410, 510, 610) in accordance with one of the preceding claims, characterised in that it is made of raw mate-

rial, with any thread (312) present on the shaft part being manufactured in a thread rolling process or in a compression forming process.

9. A functional element (10, 110, 210, 310, 410, 510, 610, 710, 810), in particular a bolt element, characterised in that the head part (16, 116, 216, 316, 416, 516, 616, 716, 816) merges into the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) without a flange part.

10. A functional element (1010), consisting of a shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) and a head part (16, 116, 216, 316, 416, 516, 616, 716, 816) designed for a riveted joint to a panel element, in particular a sheet metal part (30, 130, 230, 330, 430, 630, 730), wherein at least the head part is made hollow and has at least substantially the same outer diameter as the shaft part, characterised in that the length of the hollow head part (16, 116, 216, 316, 416, 516, 616, 716, 816) is dimensioned at least such that its length amounts to the length of a rivet flange (37, 137, 237, 437, 637, 737) formed on the side of a sheet metal part (30, 130, 230, 430, 630, 730) remote from the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) plus the thickness of the sheet metal part and the double length of the radius of an annular fold (52, 152, 252, 452, 652, 752) formed on the side of the sheet metal part adjacent to the shaft part (14, 114, 214, 314, 414, 514, 614, 714) and that a flange part (1011) is present between the hollow head part (1016) and the shaft part (1014), with the flange part (1011) optionally being able to have rotational security features on its side facing the

head part and the flange part (1011) has a spacing from the hollow head part (1016).

11. A method for the manufacture of a joint between a functional element (10, 110, 210, 310, 410, 510, 610, 710, 810) in accordance with one of the preceding claims and a sheet metal part (30, 130, 230, 430, 630, 730), wherein the functional element consists of a shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) and a head part (16, 116, 216, 316, 416, 516, 616, 716, 816) designed for a riveted joint to the sheet metal part (30, 130, 230, 430, 630, 730) with at least the head part being made hollow and having at least substantially the same outer diameter as the shaft part, and the end (20, 120, 220, 320, 420, 520, 620, 720, 820) of the head part (16, 116, 216, 316, 416, 516, 616, 716, 816) remote from the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) is made in known manner with piercing and riveting features and the sheet metal part is pierced in a known manner by the end face (20, 120, 220, 320, 420, 520, 620, 720, 820) of the functional element while the sheet metal part (30, 130, 230, 430, 630, 730) is simultaneously supported on a die (32) and is formed to form a rivet flange (37, 137, 237, 437, 637, 737) around the downwardly drawn rim of the aperture and with the functional element (10, 110, 210, 310, 410, 510, 610, 710, 810) being pressed downwards after or just before completion of the rivet flange (37, 137, 237, 437, 637, 737) to make the region of the hollow head part (16, 116, 216, 316, 416, 516, 616, 716, 816) adjacent to the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) into an annular fold (52, 152, 252, 452, 652, 752) which contacts the side of the sheet metal part (30, 130, 230, 430,

630, 730) remote from the rivet flange (37, 137, 237, 437, 637, 737) and adjacent to the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814).

12. A method in accordance with claim 11, characterised in that after the at least partial completion of the rivet flange (37, 137, 237, 437, 637), the sheet metal part (30, 130, 230, 430, 630) is pressed into an annular recess (40) of the die (32) by the annular fold (52, 152, 252, 452, 652) which is formed, with the diameter of the annular recess (40) at the end of the die being greater than the diameter of the completed annular fold (52, 152, 252, 452, 652) so as to generate an annular recess in the sheet metal part with a depth which corresponds at least substantially to the axial height of the annular fold (52, 152, 252, 452, 652), i.e. to at least substantially double the height of the wall thickness of the hollow head part, and with a diameter which corresponds at least substantially to the outer diameter of the annular fold (52, 152, 252, 452, 652) plus double the sheet metal thickness.

13. A method in accordance with claim 11 or claim 12, characterised in that pressure is exerted by a plunger (48) on the end (29, 129, 229, 329, 429, 529, 629, 729, 829) of the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) remote from the head part to pierce the sheet metal part (30, 130, 230, 430, 630, 730), while the sheet metal part (30, 130, 230, 430, 630, 730) is supported at the rim of the die (32) outside the annular recess (40) so that the piercing of the sheet metal part is accompanied by the formation of a trumpet-like recess in the sheet metal part and in that after the annular rivet

flange (37, 137, 237, 437, 637, 737) has been formed, the plunger (48) exerts an additional force on the shaft part (14, 114,. 214, 314, 414, 514, 614, 714, 814) in the longitudinal direction of the functional element so as to form the region of the hollow head part (16, 116, 216, 316, 416, 516, 616, 716, 816) arranged above the sheet metal part into an annular fold (52, 152, 252, 452, 652, 752) and in that a plunger (42) arranged concentrically to the plunger is pressed downwards so as to compress the annular fold (52, 152, 252, 452, 652, 752) and to form an annular face (57, 157, 257, 457, 657, 757).

14. A method in accordance with claim 13, characterised in that the annular face (57, 157, 257, 457, 657, 757) formed in this way is perpendicular to the longitudinal axis (24, 124, 224, 324, 424, 525, 624, 724) of the member (10, 110, 210, 310, 410, 510, 610, 710, 810) and is preferably flush with or slightly below or slightly above the plane of the sheet metal part in the region of the joint.

15. A method in accordance with one of the claims 11 to 14, characterised in that the panel slug (50, 150, 250, 450, 650, 750) formed by the piercing section of the head part is forced inside the rivet flange (37, 137, 237, 437, 637, 737) by a plunger projection (34) of the die (32) in order to further increase the strength of the riveted joint.

16. A component assembly comprising a sheet metal part (30, 130, 230, 430, 630, 730) and a functional element (10, 110, 210, 310, 410, 510, 610, 710, 810) in accordance with one of the preceding claims 1 to 10, and manufactured in accordance with one of the methods of

claims 11 to 15, characterised in that a rivet flange (37, 137, 237, 437, 637, 737) is located on the side of the sheet metal part remote from the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814), while an annular fold (52, 152, 252, 452, 652, 752) is located on the side of the sheet metal part (30, 130, 230, 430, 630, 730) adjacent to the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814), and in that the sheet metal part (30, 130, 230,430, 630, 730) is clamped between the annular fold (52, 152, 252, 452, 652, 752) and the rivet flange (37, 137, 237, 437, 637, 737) in the region of the joint to the functional element (10, 110, 210, 310, 410, 510, 610, 710, 810), in that the annular fold (52, 152, 252, 452, 652, 752) is arranged in an annular recess of the sheet metal part, with an annular face (57, 152, 257, 457, 657, 757) of the annular fold (52, 152, 252, 452, 652, 752) facing the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) being arranged either slightly below or slightly above the side of the sheet metal part facing the shaft part (14, 114, 214, 314, 414, 514, 614, 714, 814) in the region of the riveted joint, or being at the same height as the side of the sheet metal part (30, 130, 230, 430, 630, 730).

17. A component assembly in accordance with claim 16, characterised in that a panel slug (50, 150, 250, 450, 650, 750) is located inside the annular rivet flange (37, 137, 237, 437, 637, 737) and preferably presses against this.

18. A component assembly in accordance with one of the claims 16 or 17, characterised in that the sheet metal part is a composite component (1030).

19. A method in accordance with one of the claims 11-15, with a die (732) being used, having an annular recess (740) provided on one end face (733) and arranged around a centrally disposed plunger projection (734), with the plunger projection being designed to cooperate with a tubular head part (716) of a functional element (710) in order to remove a panel slug (750) from a sheet metal part (730) and with the annular recess (740) being designed to move the end region of the tubular head part (716) around the rim region (778) of the sheet metal part which is pressed into the recess formed after the removal of the panel slug and to form it there into a rivet flange (737), characterised in that the plunger projection (734) projects beyond the end face (733) of the die (732) lying outside the annular recess.

20. A method in accordance with one of the claims 11 to 15, with a die (732) being used, having an annular recess (740) provided on one end (733) and arranged around a centrally disposed plunger projection (734), with the plunger projection being designed to cooperate with a tubular head part (716) of a functional element (710) in order to remove a panel slug (750) from a sheet metal part (730) and with the annular recess (740) being designed to move the end region of the tubular head part (716) around the rim region (778) of the sheet metal part which is pressed into the recess formed after the removal of the panel slug and to form it there into a rivet flange (737), characterised in that grooves (739) are worked into the end face (733) of the die (732) around the recess (740) at preferably equal angular intervals and are preferably arranged radially and inclined to the longitudinal axis (724) of the die, whereby rotational security features

can be generated in the sheet metal part and in the adjacent material of the head part.

21. A method in accordance with one of the claims 11 to 15 for use with a functional element (810) having a shaft part (814) with form features and a head part (816), in particular a functional element in accordance with one of the claims 1 to 10, wherein a plunger arrangement is used, characterised by

- an outer plunger (842);
- an inner plunger (848) which is arranged movably with respect to the outer plunger within a plunger passage (886) of the outer plunger (842) between a receiving position for the functional element (810) and an insertion position for the functional element (810), with the functional element being able to be inserted into the plunger passage (886) when in the receiving position, preferably from the side and with the head part (816) of the functional element projecting out of the plunger arrangement (843) when in the insertion position; and
- by at least two segments (904) supported by the outer plunger which preferably have form features on one inner side (908) which can engage into the form features of the shaft part (814) of the functional element and which are movable between an open position (Fig. 18B) remote from the shaft part (814) of the functional element and a closed position (Fig. 18C) in engagement with the form features of the shaft part (814).

22. A method in accordance with claim 21, characterised in that the outer plunger has an upper part (894) and a lower part (892) fas-

tened to the upper part, with a conical recess (898) arranged concentrically to the longitudinal axis (824') of the die being provided in the lower part (892) and the segments (904) having corresponding conical surfaces (920), in that the segments are biased in each case upwardly in the direction of the upper part (894) against said upper part (894) by spring-biased tappets (928) preferably set obliquely to the longitudinal axis (824') of the plunger arrangement, with their form features being able to engage in this position in those (812) of the functional element (810) pushed forward under the pressure of the inner plunger (848) , and in that the tappets (928) can be urged rearwardly by means of a drawing force exerted on the functional element and drawing it out of the plunger passage and the segments and move against the conical recess (898) of the lower part and thus into the open position to release the functional element.

23. A method in accordance with claim 21, characterised in that the upper part (894) of the outer plunger (842) has a conical recess (900), which is also arranged concentrically to the longitudinal axis (824') of the die, to centre the segments (904) and in that the segments (904) have further conical surfaces (914) which come into engagement with said conical recess (900) in the closed position.